PLANTERS' BULLETIN

OF THE RUBBER RESEARCH INSTITUTE OF MALAYA

NEW SERIES NUMBER TWENTYTHREE

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R R I

LOCATION. The institute's laboratories and offices are at the third mile, Ampang Road, Kuala Lumpur.

CORRESPONDENCE. All LETTERS must be addressed to the Director, Rubber Research Institute of Malaya, Post Office Box 150, Kuala Lumpur. Special inquiries may be marked for the attention of particular officers. The address for TELEGRAMS is Searching, Kuala Lumpur. TELEPHONE: Kuala Lumpur 3351. PARCELS occasionally arrive without any indication of their origin. Senders' names and addresses should be written clearly on the outside of all packages, and the institute should be advised of despatch by letter or telegram.

PROHIBITED PLANT SPECIMENS. Attention of planters and others in territories outside the Federation of Malaya and the Colony of Singapore is drawn to the Malayan Plant Importation Rules which prohibit the importation into Malaya of any part of a plant, whether living or dead, unless it is accompanied by a permit issued by the Director of Agriculture, Federation of Malaya. No permit will be issued in respect of any diseased plant or any plant pest. Any plant imported in contravention of these Rules (whose object is to prevent the introduction of diseases or pests) will be destroyed without examination. Anyone outside Malaya who desires our advice on any matter that may require examination of living material must first inquire by letter.

ADVICE. Inquiries are invited from rubber producers in the Federation of Malaya, the Colonies of Singapore and North Borneo, and the territories of Sarawak, Brunei and Nigeria, who may require more detailed information applicable to their own special problems. Where it is considered necessary, visits will be made to Estates in Malaya as convenient. Visits to estates in other territories are by special arrangement. The only visits for which charges are normally made are those of the Institute's budding mandores. INTERVIEWS should be arranged by letter or telephone, as members of the senior research and advisory staff are frequently absent on visits to plantations. The institute is open from 8 am to 1 pm and 2 pm to 4 pm on Mondays to Fridays, and from 8 am to 12.30 pm on Saturdays.

EXPERIMENT STATION AND FACTORY. This station of the R R I is situated 16 miles from Kuala Lumpur, at Sungei Buloh on the Kuala Lumpur — Kepong — Kuala Selangor road. Visits may be made on Mondays or Wednesdays by arrangement. There is a guest house.

PUBLICATIONS. A list of 'Publications of the R.R.I.' is available on request. Subscription may be made by depositing $15 with us. An annual statement of account will then be submitted.

PLANTERS' BULLETIN

OF THE RUBBER RESEARCH INSTITUTE OF MALAYA

Kuala Lumpur March 1956 Number 23

Editorial: Words

The art of writing by scientists, we frequently read, is a lost one — lost as the empire of the Incas which once existed in the towering mountains of Peru or the ancient kingdom of Atlantis now overwhelmed by the ocean. It is with diffidence and some fear that we venture on this topic because we find ourselves in our own particular glasshouse and possibly presenting a target that is all too vulnerable for those who care to shoot at it. We are however encouraged to take the risk of becoming a cock-shy because of the articles and comments which have recently appeared in our distinguished contemporary *Nature*.

Scientific gatherings and conferences most frequently take place during the period of the University Summer Recess and reports of the deliberations of many of the meetings of 1955 have been appearing in scientific journals. At an international meeting of chemists lasting one week as many as 600 papers were presented and the abstracts alone formed a volume of 440 pages. The reports of all such meetings multiply into many volumes of papers and abstracts, and one regards with dismay the monumental reading task which awaits the conscientious research worker who tries to keep abreast with everything that is being done on his own particular subject.

Reporting the results of scientific work presents problems of interpretation of different international languages and of the exact meanings of technical phrases. If we examine further these problems we find that one of the greatest is to ensure that the results of research are eventually explained satisfactorily and comprehensibly to the intelligent, non-technical reader.

It is at this level of writing that the scientist receives the greatest criticism and is frequently challenged with not being able to write about his own work in language that is intelligible to the man in the street. The British Association at its meeting in September last year was concerned with what should be done to increase the public understanding of science and, more recently, our contemporary *Nature* discussed the inability of scientific men to write good English. We read with accord and much interest the article by Dr John R. Baker of the Department of Zoology, University of Oxford, and admire the presentation of his main criticisms of standards of writing in scientific papers.

Grammatically he is most critical of the blunders made in the use of gerunds and present participles — the *ing* endings of Sir Ernest Gowers. We accept his criticism and do not dwell on it because avoidance of errors in grammar can readily be attained by anyone intelligent enough to do scientific research after a little concentration on such standards of reference as those by A. Quiller Couch, H.W. Fowler and Sir Ernest Gowers.

We fully agree with the condemnation of grandiloquence. Technical words and expressions are unavoidable and may sometimes be cumbersome, but why bring in the lengthy abstractions and uncommonly used words which we see liberally sprinkled through many scientific writings. We cannot all, like Sir Winston Churchill, have the ability and mastery of language to pick always and unerringly the correct word or phrase, but we should at least use simple words.

An increasing occurrence in scientific papers of awkward piled up sequences of nouns and adjectives is referred to by Dr Baker as a German construction, and with Grammar and Grandiloquence forms the third G which he condemns. As Dr Baker points out, why say 'iron containing globules' when 'globules containing iron' is meant? We would never say 'a tea containing cup', for 'a cup containing tea'. Too often economy in words results in loss of clarity and meaning, and causes irritation to the reader when he has to examine a passage or phrase several times before it is understood.

We would add one more fault to those already quoted — the use of the cliche. So often a trite expression is put down in one's writing without due consideration being given to its true meaning. This automatic use of the cliché is lazy and slovenly writing and is to be particularly condemned and avoided.

In his defence the scientific writer can point to the tremendous output of scientific literature which seems to be increasing more and more every year. It is part of his work to assimilate these writings and, in his turn, to produce reports on his own work. Can he be blamed for using abbreviations and expressions which have specialised meanings and which facilitate his reporting?

Our excuse for having discoursed at length on a topic which may appear to have little bearing on the production of rubber is that the Institute publishes a *Journal* and a *Bulletin*, and because they are intended for different types of readers, the two publications are written in different styles. The *Journal* is the formal record of research work, scientific experiments, results and conclusions which have been formed. Journal Communications are, we hope, of value to research workers in other countries; they have to be written in conventional scientific language and contain technical expressions which are unfamiliar to the non-technical reader. Because of this, they have a limited circulation.

Planters' Bulletin is less formal and is designed to present information to the rubber planter which is of direct practical value to him on his estate or holding. The articles pass on to him latest results of experimental work, taken from the research reports, and expressed in a form which is clear and simple, yet accurate. It is our endeavour to avoid the faults of presentation of information to non-technical readers which have been mentioned earlier, and should we fail in our endeavour then the *Bulletin* falls short of its chief purpose.

R. R. I. News

The Chinese edition of the booklet *Replanting on Smallholdings* (*Planters' Bulletin 21* page 103) will be available shortly and copies will be supplied to Planters on request. The price is $1 post free in Malaya.

Please remit with order.

Weights and Measures

AS THE QUANTITY OF LATEX CONCENTRATE produced in Malaya continues to increase, the problem of determining accurately the weight of dry rubber in a bulk of preserved latex is one which interests more rubber producers. This article discusses some of the difficulties encountered in obtaining an accurate answer.

FIELD LATEX

Before a bulk of field latex is sampled it must be thoroughly mixed to ensure that the bulk is uniform. After mixing preferably three samples should be taken from the top, middle and bottom of the latex and a composite sample made for the determination of the dry rubber content (d.r.c.).

Many estates have used hydrometers to measure the rubber content of their latex. The deficiencies of these instruments are well known; they are adjusted to read correctly at 1.5 lb per gallon in average mixed seedling latex but in latex of high d.r.c they read low and in latex of low d.r.c. readings are high; they can only be read to an accuracy of half a division, equivalent to $\pm$ 1% d.r.c. at best; they do not read correctly in thick latex, particularly young clonal latex, and ammoniation of the latex also has a small effect on the reading. A chee method of d.r.c. determination is more accurate than the hydrometer methods but is still subject to errors. This method gives slightly low results for high d.r.c. latices and slightly high results for latices of d.r.c. lower than normal.

We recommend therefore that latex producers selling latex should determine d.r.c. percent by weight by the official British Standards Institution method, which involves setting up a small laboratory at an approximate cost of $500. We are prepared to demonstrate to factory clerks on request the methods of carrying out the tests and we will check occasional samples of output from estates. The usual testing fee is $10 for a d.r.c. determination at the Rubber Research Institute of Malaya, but we cannot undertake to do the routine daily checks necessary to maintain rigid control.

It is not enough to know the percentage d.r.c. accurately, the total amount of latex must also be measured. Preferably the latex bulk is weighed and the weight of dry rubber is equal to the d.r.c. (weight fraction) multiplied by the weight of latex. Many estates do not possess facilities for weighing a bulk of latex and they are obliged to measure the volume in gallons in a calibrated tank. The intricacies of accurate volume measurements are discussed below under concentrate. The weight of dry rubber is then (volume in gallons) $\times$ (weight of one gallon of latex at the temperature of measurement) $\times$ (d.r.c., weight fraction).

The weight of a gallon of latex is dependent upon the composition and the temperature of the latex. The most important variable is the d.r.c. and tables are available which list the weight of one gallon of latex at different d.r.c., but no allowance is made for the minor variations caused by differences in non rubber constituents and temperature changes. For strict accuracy the specific gravity of the latex under test should be measured in the laboratory at the temperature at which the volume is measured. On an average estate producing 600 gallons of field latex per day, it is sufficient to know the d.r.c. of the day's crop

to the nearest 10 lb. This entails measuring the volume to the nearest gallon, determining the d.r.c. to the nearest 0.1% and knowing the density of the latex to three significant figures. Hence the refinements of temperature correction and variation between latices are not normally necessary, and a TABLE, such as the following, is sufficient to determine the density.

Dry rubber content %*wt*	*Weight of one Imperial* gallon of latex (lb) at 30°C*
44	9.67
42	9.69
40	9.71
38	9.735
36	9.76
34	9.78
32	9.805
30	9.83
28	9.85
26	9.87

* *calculated from R.R.I. Information Card No. 2 April, 1948.*

LATEX CONCENTRATE

The same basic problem exists of accurate determination of the concentration of rubber present and the quantity of latex, but the scale of operations is greater.

D.R.C. Determination — Again it is important to ensure that a representative sample of the bulk is drawn for test. Methods of sampling latex concentrate in drums and in bulk storage have been discussed by both British and American Standards Committees. British Standard 1672 Part 1 1950 specifies the methods to be used. The bulk must be well stirred before samples are drawn from three levels in the tank to make a composite sample. The dry rubber content is determined by the standard method according to the British Standards Institution. This procedure must be rigidly followed in every detail because variation in the methods of coagulation may alter the proportion of non-rubbers in the coagulum and give an incorrect d.r.c. The accuracy claimed for the method is 0.2% but it is our experience that a d.r.c. can be determined with an error of 0.05% between laboratories and that with continued practice a laboratory assistant will attain an accuracy of 0.02% between duplicate determinations. It is quite certain that the fourth figure normally quoted for d.r.c. is not precisely known.

Wet weight of latex — If the latex concentrate is being drummed it is normal practice to weigh the contents of each drum and the weight of wet latex is then the sum of the nett drum weights. The weight of dry rubber is easily obtained by multiplying this wet weight by the weight fraction of dry rubber. It is important to maintain the weighing machine in good order and to have the weights regularly checked to ensure that the correct weight is being recorded.

It is not normally possible to weigh bulks of latex concentrate contained in storage tanks or ships tanks and the weight is obtained by measuring the volume in gallons coupled with a knowledge of the weight of one gallon of latex.

Measurement of volume — Bulk storage tanks are not perfect geometrical shapes and their volume cannot be calculated. Port storage tanks are often built on marshy ground and may settle and distort slightly after construction. Braced tanks are to be recommended since the distortion is considerably less. Hence it is necessary to calibrate bulk storage tanks so that the volumes of latex in the tank corresponding to measured levels in the tank are known. The level in the tank can be measured in three ways:

i by attaching a sight glass to the tank so that the level inside the tank can be seen and measured;

ii by measuring the height of the liquid level on a measuring rod which is allowed to rest on the bottom of the tank;

iii by measuring the distance from a fixed point above the tank to the surface of the liquid — this is known as an ullage dip.

Each of these methods is used in practice and we will not discuss their relative merits.

Tank Calibration — The Imperial gallon is defined as the volume occupied by 10 lb of water at 62°F when weighed in air with brass weights. The U.S. gallon is a smaller unit of volume (approximately 5/6 of an Imperial gallon) and care must be taken in shipment to U.S. ports to specify which unit of volume has been used. Water expands on heating and at normal Malayan day temperature (86°F) 10 lb of water will occupy a volume greater than one gallon. The change in volume of water with temperature has been very accurately measured and it can be calculated from reference tables that the weight of water which will occupy a volume of one Imperial gallon at 86°F is 9.9681 lb. To calibrate the tanks we weigh into the tank multiples of 9.9681 lb water and measure the dip corresponding to known weights of water at 86°F. In this way we can construct a table showing that so many inches correspond to so many pounds of water at 86°F and therefore to so many gallons of water. We continue in this way until the tank is full and we repeat the measurements while emptying the tank. All stirrers and other fittings must be in position when the tank is calibrated. The dip must always be taken at the same position and it is advisable to fit a small well at the bottom of the tank to receive the end of the dip stick and ensure that this is so.

Latex concentrate is now put into the storage tank and from our tank calibration we know the number of gallons which correspond to a given dip measurement.

The density of latex — In order to convert gallons of latex into weight of latex we need to know the weight of one gallon of the latex at the temperature at which the volume was measured. The amounts of dry rubber, water and serum solids vary slightly from one consignment to another and so the specific gravity of latex concentrate, which is a function of the constituents, will change. Additional to the variation due to differences in constituents is the change with temperature. Thus a table of specific gravity can only be an average value and the table

used by the Rubber Trade Association of London in Contract No. 10 is both incomplete and inaccurate. We understand that this contract is being revised and that the new specification will not include this table.

The specific gravity of the latex is determined in the laboratory at the temperature at which the volume was measured. This is done by filling a special bottle with latex at the temperature required, weighing it and then weighing it full of water at the same temperature. The ratio of the weight of latex filling the bottle, to the weight of water which fills the bottle, is the specific gravity of the latex at that temperature, usually written $(S.G.)_T^T$.

Weight of 1 gallon of latex at $T^\circ = (S.G.)_T^T \times$ (weight of 1 gallon of water at T°). The weight of one gallon of water at the desired temperature T° is computed from tables. The tables give values in grams per millilitre for the density of water when weighed in a vacuum and the value has to be converted to weight in air by using the appropriate correction factor (1.00106 from standard tables).

To take an example:

1 millilitre of water weighs 0.99597 gm at 29°C *in a vacuum*

1 millilitre of water weighs $\frac{0.99597}{1.00106}$ gm at 29°C *in air*

1 gallon of water weighs $0.99597 \times \frac{10.022}{1.00106}$ lb at 29°C *in air*

which equals 0.99597×10.0114 lb.

(10.022 is the factor to convert from gm/ml to lb/gallon)

Hence weight of 1 gallon of latex at T°

$= (S.G.)_T^T \times$ weight of 1 ml of water in gm *in a vacuum* $\times$ 10.0114 lb.

It is permissible to measure the specific gravity of the latex at the laboratory temperature, provided it lies within a few degrees of the loading temperature, and to apply a small correction, because the change of specific gravity of average concentrate with temperature is 0.00014 per °C in the temperature range 25 – 35°C.

Below 25°C very few figures for latex concentrate specific gravity have been published. It is likely that the temperature corrections applicable in the range 25 – 35°C will not be correct at lower temperatures and it is preferable to determine the specific gravity at exactly the temperature at which the gallonage was measured. This applies particularly to shipments received in non-tropical climates.

On reaching its destination latex is usually off loaded into bulk storage tanks. At a few American ports latex concentrate is discharged into weighed rail or road tankers and the bulk is thus weighed directly, enabling the weight of dry rubber to be directly computed without resource to volume. Normally, however, the problems of determining the gallonage and the weight of one gallon of latex are the same as in the country of origin.

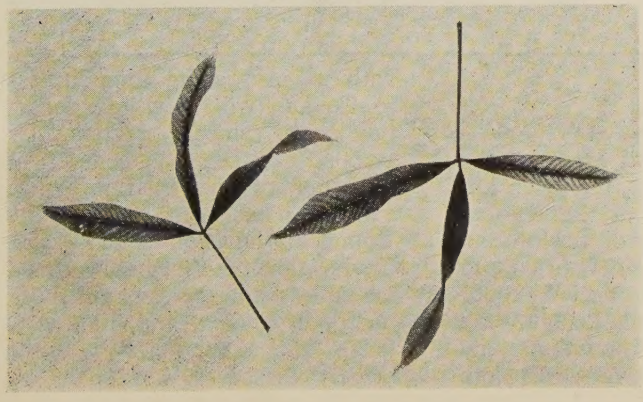
Magnitude of experimental error — For a bulk shipment of 60,000 gallons of latex concentrate an error of 0.05% in the d.r.c. determination results in a discrepancy of 300 lb of dry rubber, an error of ten gallons in the volume measurement gives a discrepancy of 50 lb and an error in specific gravity determination of 0.0002 gives a discrepancy

of 110 lb. It can be seen that experimental error alone requires a latitude of ± 500 lb of dry rubber in a shipment of about 340,000 lb. The importance of accurate measurement of volume, density and d.r.c. is clearly indicated from the above considerations, which show that at best a latitude of 0.3% can be expected. If cognizance is not taken of the precautions outlined in this article the opportunity for greater divergency is considerable.

Zinc deficiency of *Hevea* in relation to *Oidium* infection

Figure 1. Plant fed with complete nutrient diet, on left; plant deficient in zinc, on right. Tjir 1 seedlings, one year old. Each scale division equivalent to three inches.

RECENTLY, FOR THE FIRST TIME, zinc deficiency symptoms were produced in young rubber seedlings grown in sand culture The symptoms, which have not yet been identified in the field, were clearly defined; the deficiency caused severe stunting and retardation of growth (*Figure 1*). The younger leaves became narrow, strap-like and were often twisted or or hooked (*Figures 2 & 3*); when the deficiency was less severe long leaves with undulating margins were produced.



It was most noticeable that the leaves of zinc deficient plants became severely infected with *Oidium heveae*

Figure 2. Narrow twisted leaflets taken from top of zinc deficient plant.

Figure 3. Young leaves taken from zinc deficient plants. Note tip hooking of uppermost leaflets and 'claw' shape of lowermost leaflets.

(*Figure 4*). While it was true that plants supplied with zinc showed occasional colonies of *Oidium heveae* the intensity and severity of the attack were much less marked than observed in zinc deficient plants. It thus appeared that a state of zinc deficiency predisposed the plants to infection by *Oidium heveae*.

Lack of available zinc is not expected to occur frequently in the highly acid soils of Malaya but it seems credible that when *Oidium heveae* is prevalent in certain areas or countries that the infected plants may be zinc deficient.

Figure 4. Severe Oidium heveae infection of leaves of a zinc deficient plant.

R. R. I. News

Dr E.D.C. Baptist, Head of the Botanical Division, has been appointed Director of the Rubber Research Institute of Ceylon and left Malaya early in February to take up his new post. We offer him our congratulations on the appointment and know that many of our readers, who will join with us in wishing him success in Ceylon, will view his departure with sincere regrets. Dr Baptist has been a member of the staff of the Institute since 1936 and has been Head of the Botanical Division since 1950. During that time he has rendered valuable service to the rubber industry in Malaya and his knowledge and experience will be greatly missed.

A New Weedkiller for Control of Grasses

During the past year several small scale trials, mainly for control of grasses, have been carried out at the Rubber Research Institute Experiment Station to test a new weedkiller, called Dalapon. The effects of this new weedkiller have been compared with those of other weedkillers commonly used on rubber estates such as sodium arsenite, sodium chlorate, a mixture of sodium chlorate and sodium borate, sodium trichloroacetate (Lallicide) and Shell Lalang Oil. Dalapon is more effective than all of the others.

Dalapon offers considerable promise for use in rubber areas. It is proving to be unusually effective for control of grasses most commonly found on rubber estates; these include *Axonopus compressus, Paspalum conjugatum, Hemigymnia fusca* (*Panicum nodosum*) and *Panicum sarmentosum.* In fact, all grasses in the trial plots were killed and re-colonization by grasses did not occur for several months. The treated plots were colonized first by other herbaceous plants such as *Oldenlandia dichotoma, Ageratum conyzoides* and *Hyptis suaveolous,* while grasses came in later. Where *Mikania scandens* or other creepers are growing in association with grasses it is expected that after spraying with Dalapon these would cover the ground before the grasses re-establish.

Browning of the grasses occurs at varying times within the first fourteen days after treatment, depending on the rate of application, but the maximum effect may be delayed for as long as two months. Rate of recovery is very much slower after treatment with Dalapon than after treatment with the other weedkillers. Rates of application tested were 10, 15, 20 and 25 lb per acre. The estimated effect of the lowest rate of application was 95% kill; with the higher levels of application grasses were completely killed.

Re-colonization of the treated plots by grasses began at varying times after treatment depending on the rate of application, but even with the lowest rate (10 lb per acre) there was no noticeable recovery for about four months. With applications at the rate of 15 lb per acre there was little or no recovery until about seven months after treatment. About 15 lb per acre is probably the minimum dosage for effective control of the smaller grasses.

The evidence available so far indicates that grasses in young immature rubber areas can be controlled successfully by spraying with a solution of Dalapon at the rate of 15 lb of the salt per acre twice a year. Spraying treatment once a year would probably be sufficient in mature rubber areas.

Dalapon kills grasses rather more slowly than sodium arsenite and sodium chlorate but the effect lasts much longer. In this respect it is similar to sodium trichloroacetate (Lallicide) but is more effective in that smaller quantities are required to produce a similar effect.

Dalapon also kills lalang and it can be said that it is more effective than either sodium arsenite or Lallicide. However, the early trials on control of lalang have not yet been followed up and we are not in a position to say what would be the optimum rate of application. Preliminary results show that rate of regrowth from rhizomes is much slower after treatment with Dalapon than after treatment with sodium

arsenite and it seems probable that lalang could be weakened sufficiently to allow for effective control by wiping after two rounds of spraying with Dalapon.

Trials have been carried out to discover whether Dalapon sprayed on ground cover in the planting rows has any harmful effect on rubber trees. Two applications of dosages up to 50 lb per acre had no detectable harmful effect on seven years old trees. In another area where the trees were two years old no undesirable effects were observed where Dalapon was applied in the planting rows close to the trees at rates up to 25 lb per acre.

There is some evidence to suggest that leguminous creepers and *Mikania scandens* are more tolerant to treatment with Dalapon. This requires confirmation and further trials are in progress. It would be an important factor favouring the new weedkiller if the trials confirmed that it is herbicidally more active on grasses than on some of the broad leaf species of plants which are more acceptable as ground cover in rubber areas.

Dalapon is the trade name for the sodium salt of 2,2-dichloropropionic acid. It is readily soluble in water and is not highly toxic to animals.

Laboratory investigations in the U.S.A. have established that Dalapon is actively absorbed and translocated by living grass foliage and is also absorbed by roots. It disappears fairly rapidly from the soil so there is little risk of any harmful effect to crop plants due to accumulation of large quantities following repeated spraying. Under field conditions loss by leaching is an important factor but disappearance from the soil is also due to breakdown of the chemical. Dalapon decomposes fairly rapidly in warm, moist soil as a result of soil microbial activity.

Quality of Latex Concentrate

Communication 297 of the *Journal of the Rubber Research Institute of Malaya* entitled 'Volatile Acids and the Quality of Concentrated Natural Latex' describes some of the experiments which demonstrated the effect of volatile acids upon the properties of latex concentrates. The influence of different levels of VFA number upon the mechanical stability of a concentrate and upon rate of increase on storage is considerable. Factors responsible for the rapid development of VFA include delayed ammoniation, insufficient preservative and admixture of factory residues with fresh latex. A shortened version of the original VFA method is described and the value of conductivity measurements as a substitute for VFA determinations is discussed. The VFA is contained exclusively in the water phase so that recentrifuging a poor latex reduces the VFA content.

Of the bacteria which exist in latex the acid producing ones are probably the most important. VFA is the chemical manifestation of the presence of these acid producers but gives no clue to the activity of other types of bacteria. A measure of VFA development remains a powerful diagnostic tool to probe each step in concentrate production.

Rubber Wood as a Raw Material for Paper Pulp or Building Boards

We have pleasure in presenting an article by the Chemist of the Forest Research Institute, Malaya. The possibilities of utilising waste rubber wood arising from replanting operations are discussed. Preliminary tests on Hevea show that the material is sufficiently promising to justify full laboratory investigation.

THE SIGHT OF ROWS OF RUBBER TREES being felled and stacked for burning in replanting schemes has caused many people to wonder whether industrial applications exist for rubber wood. The large amount available, its ease of extraction in sizes approximating to pulpwood billets, the time over which supplies are likely to last and, above all, its homogeneity are factors which favour its use as pulpwood or for the manufacture of resin-bonded chipboard.

The author believes that rubber wood, if it is shown to be technically suitable, is the most likely of Malayan cellulosic materials to be used by a pulp mill, although it may not be used exclusively or indefinitely. It is the first material selected for examination at the Forest Research Institute, where work is directed towards the discovery of some encouraging materials and techniques which may be pursued further by prospective manufacturers with larger organisations oversea.

This article describes the products which might be made from rubber wood and the processes which would be employed in their manufacture. The availability of supplies and technical suitability of the material are discussed.

POSSIBLE PRODUCTS – DESCRIPTION AND MANUFACTURE

Resin-bonded Chipboard — This board is not a pulp product. It is made by reducing wood to small particles (*e.g.* by hammermilling) or to shavings (with special machinery) which are then spray-coated with a thermo-setting resin. The particles are spread out two to three inches thick on trays and compressed at about 700 lbs per sq in. and at 160°C to furnish a smooth sided board of density somewhat greater than the wood from which it is made. Turned out in thicknesses ranging from $\frac{3}{8}$ inches to $1\frac{1}{2}$ inches and in 'sheets' of the order eight feet by four feet (or in continuous 'sheets' by certain processes), the boards are stable towards changes in humidity, are water resistant (but unsuitable alone for exterior use) and can be worked with ordinary wood working tools. Preservative chemicals may be incorporated in the resin to render boards resistant to termites.

Although only slightly known on the Malayan market, this board is extensively used in Europe and America for furniture, including prefabricated doors, and partitioning, particularly in hotels and restaurants. Veneers and plastic surfaces are frequently applied to the standard product.

Fibreboard — The two kinds of fibreboard, *viz.*, hardboard and insulating board, are well known in Malaya. Both are made from wood by producing chips which are then reduced to a coarse pulp (*i.e.* the

individual wood fibres are separated) by being passed through disc refiners. A disc refiner consists essentially of two rotating steel discs, grooved in a special way, and held apart a few thousandths of an inch. The chips may be either softened before introduction to the refiner or fed in directly at high temperature under steam pressure. The pulp is formed into wet mats on wire screens. For making into insulating boards, the mats are hot air dried; for making into hardboard, they are hot pressed at about 700 lbs per sq in. and 170°C. In both instances, it is fibre-fibre bonding, developed during refining, which largely provides the strength of the structure. Some sizing material or wax may be added to the pulp to improve the water resistance of the board, or a little synthetic resin to increase stiffness. Boards for use in certain climates are frequently treated with a preservative after manufacture.

Malayan consumption of these boards has risen steadily since 1947 and this year will probably exceed 12,000 tons. Insulating board is being increasingly used in the United Kingdom as a permanent shuttering for concrete and as a lining material in buildings to lower heat losses through walls: in Malaya, its use in buildings is increasing in order to keep heat out, *e.g.* in air-conditioned rooms and for ceilings.

Paper — Paper is made from pulp prepared mechanically, chemically or semi-chemically. In the first method, logs are pressed lengthwise against rotating grindstones in the presence of large quantities of water, whereby the fibres are rubbed loose singly or in bundles. This kind of pulp is prepared in about 90% yield, cheaply, but the strength of paper made from it is low. In the chemical processes, the wood is chipped and cooked for several hours under pressure with strong solutions of chemicals, *e.g.* caustic soda, which dissolve the lignin in the wood, thereby freeing the fibres. The resultant pulp, after washing, represents about half the original wood substance, and is capable of being made into strong papers. Semi-chemical cooking involves lightly cooking wood chips in weak chemical solutions in order to soften them for defibering in disc refiners. The pulp is prepared in about 70% yield.

Pulps made from different materials and by different processes are blended before being beaten, depending on the quality and properties of the paper required. Beating is a process whereby the individual fibres are roughened and swollen and involves the passage of the pulp in a weak suspension through special machines. An example of blending is afforded by newsprint, where a combination of cheapness, rapid ink absorbing power and sufficient strength for high speed printing is achieved by mixed 80% coniferous, poplar or eucalypt mechanical pulp with 20% coniferous chemical pulp.

Paper is made from pulp on the highly specialised Fourdriner machine, which is essentially an endless wire gauze on to which a pulp suspension flows. The water passes through the wire and the fibres form a wet sheet on top, being carefully transferred at speed to a long series of heated drying rolls. Due to the many varying details of manufacture in the production of different papers, it is not possible for a small mill to make a wide selection.

Malayan consumption of paper in 1954 was in round figures, 13,000 tons newsprint, 3,000 tons wrapping paper, 10,000 tons old newspapers, and 8,000 tons printing and writing paper.

SIZE OF ENTERPRISE—OUTPUT AND MACHINERY COSTS

The above descriptions of manufacturing processes are merely outlines of techniques requiring expensive machinery and close control of processing conditions. Also, the production costs of these processes are economically attractive only when the outputs are large, *e.g.* of the same order as Malayan national consumption. The possibility of exporting to other countries is difficult to assess although the consumption of pulp products in Asia is rising steadily and even small increases in literacy and standards of living will cause very large increases in consumption. This rise is not restricted to Asia, and is being accompanied by the building and planning of new pulp mills all over the world.

The author believes the high investment required for building and equipping a pulp or board mill to be the largest single factor operating against its establishment in Malaya. Conditions and processing costs vary from one country to another, but from opinions given to the author in Europe and from F.A.O. publications, one may take the following figures to express at least the orders of machine costs and minimal economic size.

THE PROBABLE MINIMAL ECONOMIC SIZE AND THE CORRESPONDING MACHINE COSTS FOR VARIOUS TYPES OF MILLS

Type of mill	*Output (tons/day)*	*Input (tons/day, equiv. air dry wood)*	*Approx. machine costs in Malayan dollars*
Resin-bonded chipboard mill	20	25	800,000
Fibre-board mill	25	30	2,500,000
Mechanical pulp mill	50	45*	3,600,000
Associated paper mill	–	–	2,700,000
Semi-chemical (cold soda) pulp mill	50	65	4,500,000
Associated bleach plant	–	–	1,000,000
Associated paper mill	–	–	3,600,000
Chemical (sulphate) pulp mill	100	200	17,000,000
Associated bleach plant	–	–	4,000,000
Associated paper mill	–	–	8,000,000

* *assuming chemical pulp for admixture is bought from oversea*

The use of second-hand machinery can reduce some of these costs considerably, but the author is not competent to discuss this aspect of a pulp industry. There are many organisations in Europe and America, experienced in establishing new enterprises, which could examine Malayan conditions in detail and give exact financial and technical requirements.

AVAILABILITY OF SUPPLIES

Consideration of the supply of raw material has two aspects, *viz.* whether enough can be obtained in a certain locality and what will be used when large scale replanting decreases in, say, ten years' time.

The former depends on the distance over which it would be economically sound to bring the material. The price of pulpwood in Europe and America is of the order $30 per ton weight, (air-dry), and although it cannot be assumed that this price could be paid by a Malayan pulp mill, it enables the following estimate to be made. If $10 per ton be allowed for felling, cutting into convenient sizes and loading, $20 may be spent on transport, which would cost about 0.40 cents per ton-mile. Thus, a collecting radius of about fifty miles would seem to be economic, although specialised or rail transport may extend the distance considerably.

The amount of wood required daily is between 25 and 200 tons, and the present rate of replanting is about 50,000 acres per year. The author has been informed that a felled plantation yields about 90 tons (stacked) of firewood per acre, say 35 tons weight of wood (air-dry), of which it is assumed, arbitrarily, that 17 tons would be used as domestic firewood (branches and tops left after cutting billets of standard length, about 4 feet long). Thus, some 900,000 tons weight (air-dry) of wood are available per year, and the remaining point to consider is the distribution of this material. If it is further assumed that the replanting is taking place fairly uniformly throughout the whole 3,700,000 acres of plantations in the country, there should be about 0.2 ton weight per year of wood for each acre of plantation within economic hauling distance, *viz.* 50 miles, from the mill.

If a mill were to operate at Kluang, Gemas, Seremban, or Cheras, localities which offer good facilities with regard to water supply, transport and other facilities and availability of labour, it may be calculated that a supply of over 400 tons per day could be maintained. Further north, it appears that 200 tons per day could be obtained at Kuala Kangsar although the calculations are crude, ample supplies should exist for all types of mills except possibly the chemical (sulphate) pulp mill.

With regard to the effect of the cessation of large scale replanting, it may be said that it is not likely to be serious for chipboard or hardboard manufacture, since other materials, *e.g.* mixed forest woods, are available and some are known already to be technically suitable. For the more highly tuned paper factory, the disappearance of a homogeneous material could probably be offset only by the appearance of another. In spite of technical developments in the pulping of mixed tropical hardwoods (*i.e.* woods from broad leaved leaves) the author believes the establishment of pulpwood plantations to be the surest way of guaranteeing supplies. Several tree species are to be examined as soon as possible for their pulping characteristics, but most noteworthy of all is batai, *Albizzia falcata,* which has been favourably reported on by several laboratories. Available figures indicate that a plantation of 10,000 acres run on a ten year rotation could furnish some 70,000 tons of pulpwood annually. It is suggested that a mill would switch

from rubber wood to batai wood in processes requiring uniform material, *e.g.* mechanical pulp, when supplies of the former begin to be less readily available.

TECHNICAL ASPECTS

There is one aspect of great importance to all processes, *viz.*, the storage of wood supplies stocks possibly being required for operations over several months. Rubber wood is very prone to fungal and insect attack which not only cause loss of material but can spoil the appearance and lower the quality of the products. Some small trials will be arranged but it is very likely that unless the wood can be used within two to three weeks after felling it will require under water storage.

Resin-bonded Board — It has been shown by trials in the United Kingdom that resin-bonded boards of satisfactory strength can be made from rubber wood. These boards have a low water resistance compared with those made from usual British materials or from other Malayan woods. Admixture with other Malayan woods (sawmill waste) has been shown to improve this feature, but it must be stressed that the conditions of test were stringent. Further trials with water repellent material would very likely bring about improvement but the boards as already prepared would be quite suitable for most applications. The appearance of the bare boards is not pleasing, but as mentioned earlier, most uses of chipboard call for veneered or coated surfaces. The preparation of the boards would require the incorporation of preservative.

Fibre Board and Paper — Both these products have been made from rubber wood, the former (hardboard) in a trial in Germany a few years ago, when it was found satisfactory, the latter by the Japanese in a paper mill (mechanical pulp) in Kuala Lumpur. Although the quality of the paper made by this mill is reported to have been not high and the mill closed down after the war, these facts are not in themselves discouraging. The mill employed old equipment, bleaching chemicals were unobtainable and the amount of research or technical trials could hardly have been extensive. In the circumstances, its products could not expect to compete with higher quality materials available when hostilities ceased.

The most important properties of a wood to be used for pulping are its fibre dimensions which are largely characteristic of a species. The dimensions show a Gaussian type of distribution, and averages of 100 – 200 measurements are usually quoted. A wood fibre is hollow and tapering (the space within being called the lumen) but the thickness of the wall is fairly constant from one end to the other. The fibres are 'packed' vertically in the tree, 'cemented' together with lignin, and constitute about 80% of the weight of wood substance. The average dimensions of the fibres of *Pinus sylvestris, Eucalyptus regnans, Hevea brasiliensis* and *Albizzia falcata* are given below. The first two trees are widely used in Europe and Australia respectively as sources of pulpwood, and the dimensions may be taken as typical for the species. The dimensions given for the two Malayan species are taken from preliminary measurements on single samples, but wider surveys are being undertaken. The dimensions of a mangrove species, *Rhizophora apiculata,* known to be poor for pulping, are given for comparison.

THE FIBRE DIMENSIONS OF CERTAIN SPECIES

Species	*Fibre length mm*	*Diameter mm(D)*	*Cell wall thickness mm(W)*	$\frac{2W}{D-2W}$
Pinus sylvestris (springwood)	3.0	0.05	0.002	0.11
Eucalyptus regnans	1.0	0.015	0.0020	0.37
Albizzia falcata	1.2	0.035	0.0031	0.21
Hevea brasiliensis	1.4	0.022	0.0022	0.25
Rhizophora apiculata	1.5	0.024	0.0082	2.2

The pine, which is the only conifer, is characterised by its long fibres. However, of more importance than absolute values are the relative values expressed by the ratios length/width and cell wall thickness/lumen diameter (column 4). A high value of the former implies that paper made from such fibres would have high tearing resistance, and a value of the latter less than 0.5, when the thin walls may collapse and flatten easily, implies high tensile strength. Paper from rubber wood would therefore not be expected to have high tearing resistance (although this could be improved considerably by admixture with 5-10% long-fibred pulp). However, its thin cell wall is very encouraging, for eucalypts furnish strong paper and batai (*Albizzia falcata*) has been shown in laboratories to do so. On the other hand, the thick walled *Rhizophora apiculata* was shown in Australia to be poor for paper making.

Another important property of pulpwood is its chemical composition. Partial analyses of four of the above woods are presented below. Chemical composition of wood samples of the same species vary considerably, but general features are specific. The analyses of the pine and eucalypt are typical, but those of the two Malayan species are of the only samples examined to date.

CHEMICAL COMPOSITION OF CERTAIN SPECIES

Species	*Holocellulose %*	*Cellulose % (Kurschner)*	*Lignin %*	*Pentosan %*	*Resin %*	*Water solubles %*	*1% alkali solubles*
Pinus sylvestris	68.0	45.0	27.5	10.2	4.0	3.7	20.0
Eucalyptus regnans	72.0	–	23.9	16.0	3.8	5.4	14.2
Albizzia falcata	63.9	48.6	25.8	14.7	1.7	4.8	16.0
Hevea brasiliensis	65.7	43.9	23.3	18.0	3.9	6.0	19.7

The rubber wood sample has a low holocellulose content, which indicates, unfortunately, that pulp yields may also be low. This feature is consistent with the high pentosan content and alkali solubility and low cellulose content, since pentosans and hemicelluloses are easily lost in isolating holocellulose. Pulping and bleaching procedures will therefore require careful investigation, but the yields would certainly not be too low to discourage use of rubber wood (note: another sample of *Albizzia falcata* contained 72% holocellulose). The resin content is not high, but it will be necessary to see if residual rubber hydrocarbon remains on the surface of barked logs. The water solubility is high and that may cause higher chemical consumption. However, chemical analyses are of greater value when compared with the analyses of corresponding pulps with a view to observing the amounts of components removed during the process. The composition of rubber wood does not make it unattractive.

Resumé — Rubber wood is available in quantities sufficient to supply a mill making resin-bonded chipboard, fibreboard or certain kinds of paper. The machinery for such mills is expected to cost between $800,000 and $29,000,000, depending on the process used and product manufactured. Preliminary tests show that chipboard and hardboard can be made from rubber wood and, under difficult conditions, paper has actually been made on the industrial scale. The fibre dimensions and chemical compositions of the material are encouraging, and full laboratory investigation will be started shortly.

By courtesy of the Director of Forestry, Federation of Malaya.

J.D. PEEL

Methods of Application of Fertilisers

MALAYAN SOILS GENERALLY have a low status of fertility which can be attributed mainly to poor reserves of available plant nutrients. It is generally accepted that fertilisers must be added to most soils in rubber areas at different stages during the growth of the trees. The economic and efficient utilization of fertilisers applied is a matter of great importance.

It is becoming increasingly evident that there is much confusion of thought regarding methods of application of fertilisers. A variety of methods are commonly used on different estates and observations made in several areas have clearly indicated that some of these are unsuitable and relatively ineffective. A brief description of methods which we consider suitable for application to rubber plants of different ages may therefore be of interest. The recommendations are based partly on results of field experiments but mainly on general observations in rubber areas on estates where different methods of application have been used, and on such knowledge that we have concerning the behaviour of the various fertiliser ingredients when added to soils.

MANURING AT THE TIME OF PLANTING

The common practice is to give an application in the planting hole just before planting, using either Christmas Island rock phosphate or Sterameal Planting Hole Mixture. Whichever fertiliser is used it should be well mixed with the top six to eight inches of soil in the planting hole. Although not always done, thorough mixing of the fertiliser with the soil layer which will be first occupied by the roots of the young plant is important and worth emphasising. The initial application in the planting hole is probably the most effective of all fertiliser treatments and deserves careful attention to ensure that the job is done efficiently. This is the only time when phosphate (or organic manure if Sterameal is used) can be thoroughly incorporated with the soil in the root zone at little cost. The efficiency of utilization of subsequent applications of any form of phosphate, whether broadcast on the surface or pocketed, is undoubtedly less. In regard to manuring at the time of planting there is experimental evidence to show that mixing of the phosphate with the soil in the planting hole is more effective than either band placement below the surface or application on the surface.

POST-PLANTING MANURING

Pocketing of fertilisers during the first few years after planting is not recommended.

For the first application at one or two months after planting the fertiliser should be sprinkled on the ground over a band not less than nine inches wide immediately around the base of the young plant. This gives uniform distribution over a circular area about eighteen inches in diameter and is preferred to placement in a narrow band or channel a few inches away from the plant. On bare soil, the fertiliser should be lightly forked or scraped into the surface soil. Where a layer of mulch has been placed around the plants, this need not be removed for purposes of manuring, and the fertiliser may be sprinkled on top of the mulch, without forking or scraping. The fertiliser is soon washed through the type of mulching material normally used in rubber areas, and the soil below will be in a suitable condition to allow easy penetration of the dissolved manures into the root zone.

Subsequent applications of the fertiliser will normally be distributed over a larger surface area and at increasing distances from the base of the plant. At least part of the fertiliser dosage given for the second application will fall outside the circle covered by the mulch (if mulching is done), and if the ground is bare the fertiliser will usually penetrate into the root zone more easily if the surface soil is lightly forked.

With older rubber plants the volume of soil exploited by the roots is larger and the area covered by the fertiliser mixture should be increased accordingly. As the nitrogen component is important, the mixture should be placed to cover as much as possible of the zone of rubber roots. Where ground covers are dense in the spaces between rows of trees it is expedient to broadcast the fertiliser in the cleared spaces along tree rows. There is no objection to continued applications in these cleared spaces. When the roots of two adjacent trees in the row are considered to meet, it is recommended that the application be

broadcast over the whole of the cleared space between the two trees. There is no valid reason for a common belief that none of the fertiliser should be placed close to the base of the tree and we would prefer to utilize the whole of the available cleared space rather than placing the fertiliser in a restricted region near the root extremities.

Another method which is sometimes favoured for manuring in the second and subsequent years after planting is the application of fertiliser on both sides of the planting rows along strips which have been sprayed with poison. This is a good alternative method, but again we would advise broadcast application in the sprayed strips in preference to pocketing.

Coming now to the problem of manuring rubber trees which are three years of age and older, the question to decide is whether pocketing of the fertiliser at this stage would be better than broadcast application.

The pocket method of application should never be used in areas where the soil is very sandy. In such areas fertilisers should always be broadcast at all stages of growth of the rubber trees.

We are not able to express very definite views on the relative merits of pocket and broadcast methods of application on ferruginous sandy loams, loams and clay loams. These are soils which occur most frequently in Malaya. There are theoretical reasons for believing that phosphate might be utilized more efficiently when it is placed in pockets or channels, and there is experimental evidence to show that this method of application of phosphate is effective. In most of our field experiments in mature rubber areas, both at the Experiment Station and on estates, the phosphate has always been pocketed while the sulphate of ammonia and potash fertiliser have been broadcast. In some of these experimental areas results have shown a marked response to phosphate in terms of both yield and growth. Therefore it can be stated that pocketing is effective but we are not in a position to say that broadcast application of the phosphate in the same areas would not have been equally effective. The experiments where the two methods are compared have, unfortunately, not yet yielded any positive results and it is not possible to say definitely that one method is better than the other.

Regarding sulphate of ammonia, it is quite certainly utilized most efficiently when it is broadcast to cover as much as possible of the root zone. Bearing this in mind we are inclined to the view that when manuring with mixtures, of which nitrogen is a particularly important component, it is better to adopt the broadcast method of application. Pending further results from experiments in progress to compare the two methods we would still prefer to pocket the phosphate when it is applied separately. A common procedure for manuring in mature areas is to apply sulphate of ammonia and phosphate separately in alternate years, whereby it is possible to broadcast the nitrogenous fertiliser and to pocket the phosphate.

MANURING OF MATURE RUBBER AREAS

In mature rubber areas, sulphate of ammonia or mixtures containing nitrogen and phosphate are most commonly used, while potash is also included in the mixtures required for very sandy soil areas. All these

manures should be broadcast over the ground to cover a fairly large proportion of the area occupied by the roots of the rubber tree.

Whether the fertiliser is put down in the middle of the avenues or along tree rows will depend on the composition and density of ground cover. When the ground cover consists mainly of grasses and other small herbaceous plants it is usually most convenient to broadcast the fertiliser in a wide strip between tree rows after spraying the cover with a solution of herbicide. Such spraying, we suggest, should be on a strip not less than eight feet wide.

We consider, however, that there would be no objection to application of fertilisers in the cleared spaces along tree rows where there is a dense and well controlled cover of upright indigenous growths in the spaces between tree rows. Elimination of this good type of ground cover by spraying, merely for the purpose of manuring, would not be considered an advantage because the fertiliser can, quite easily, be broadcast in the cleared spaces which are maintained along tree rows. There is no evidence to support the view, held by some, that the maximum concentration of feeding roots occurs in the region midway between tree rows.

FORKING IN FERTILISERS

Whenever fertilisers are placed on bare ground in clean weeded strips along planting rows it is usually advisable to do some light forking or scraping. This applies in particular to young areas where clean weeded strips are maintained by changkolling. A hard crust often forms on the surface of the exposed soil, and the purpose of light forking or scraping is to break this crust. If this is not done, the fertiliser may be washed over the surface of the ground and carried away out of reach of the young rubber plants.

In areas where ground covers along the planting rows are controlled by spraying (as opposed to complete removal by changkolling), there is less need for forking the fertiliser into the surface soil. The dead vegetation acts as a mulch which prevents caking of the surface layer of soil and also helps to restrict the lateral movement of the fertiliser over the surface.

In older areas where fertilisers are frequently broadcast in the avenues between tree rows there is usually no need for forking or digging unless the soil has been exposed for a long time. But even in areas completely free of growing covers, the dead leaves on the surface of the ground and the canopy above usually provide sufficient protection to prevent the formation of a hard impermeable crust on the surface. There is no doubt that incorporation of fertilisers with the surface soil would be an advantage in all circumstances, but we doubt whether the extra expense of forking or digging in mature areas would be justified. We would advise forking or digging only when it is absolutely necessary to prevent loss of fertiliser by surface wash and to make conditions favourable for easy penetration of the fertiliser into the root zone. Where fertilisers are placed on a hard exposed soil surface, forking or digging is advisable.

Ridley Centenary at Singapore

THE SINGAPORE BOTANIC GARDENS celebrated the Centenary of Henry Nicholas Ridley's birth by an exhibition describing his work and its subsequent development in Malaya. The history of the exploitation of *Hevea brasiliensis* was ably demonstrated and is briefly described below.

In 1876 the Royal Botanic Gardens at Kew received the seeds collected by H.A. Wickham in the Amazon valley. The following year twenty two seedlings were sent to Singapore in a Wardian case as illustrated. Mr H.M. Murton was Superintendent of the Gardens and planted nine seedlings in Singapore, nine in Kuala Kangsar, one at Telok Anson and one at either Taiping or Matang.

A Wardian case.

Although the progeny of these trees were planted in scattered places, there could be no interest in *Hevea* as a crop until a tapping system had been devised, and of the many who helped in the advance towards present day methods, Ridley provided the most important contribution. This was a demonstration that *Hevea* yielded best when tapped by a process of excision, in which the wound opening the bark must be frequently and regularly reopened to induce the flow of latex. This method of cutting away bark contrasted with the only other known method used in the Amazon valley, whereby axe incisions were made without the removal of bark. This was wasteful, damaging to the tree and not very productive.

The first tapping of Hevea in the East was by H. Trimen in Ceylon (1882), also using an incision system. Sir Hugh Low employed Dyaks to tap the trees at Kuala Kangsar in 1886. They made incisions on a herring bone pattern such as they used to collect other juices from native trees, but this was a failure.

Continuous tapping was developed by Ridley in 1889. At first a sharp carpenter's chisel and mallet were used, the cuts being sloped on a herring bone pattern. Ridley reopened the cuts regularly until two and a half inches of bark had been excised from each, thereby inducing a greater flow of latex without harming the tree. The trees were then rested, and with this innovation the industry began.

Further developments of tapping were mainly by planters, many of whom attempted bold and fanciful systems such as long spirals encircling the tree several times or multiple herring bone cuts. It was found that excessive length and number of cuts interfered with the general flow of latex, and reduction followed to a single cut. Periods of rest

A long spiral encircling the tree nearly four times. An extreme multiple herring bone system. Reduction a single 'V'.

between continuous tapping were given, but when it was found that tapping could be continued longer without apparent harm, regular tapping became the rule. Due to the orientation of the latex vessels the left hand sloping cut of a 'V' opens more vessels than the right hand, Hence the latter was discarded and the half spiral, tapped regularly every alternate day, emerged as a standard system.

The particular tree illustrated here which is being tapped on this system forms an interesting link with Ridley's experiments and the later developments. It was planted in 1922 and budgrafted with a bud from one of the highest yielding trees in the early experiments. It has been occasionally tapped in the past and was reopened for the Ridley Centenary Celebrations. The tree has now attained a large girth with thick bark; the two cups of latex shown are the yield of a single tapping.

The budgrafted tree tapped on a half spiral, which is described in the text.

The first blocks of rubber-bearing trees of both *Hevea* and *Ficus* in Malaya were planted by Mr Tan Chay Yan at Bukit Lintang Estate, Malacca in 1898. From this first forty acres the area planted with rubber in Malaya has increased to more than three and a half million acres. During these years other developments have taken place and some of the major milestones formed part of the exibit.

The variability of yield in seedling trees was studied in 1913 by G.S. Whitby in Malaya and R.H. Lock in Ceylon. This lead W.M. Van Helten in Sumatra in 1917 to develop the budgrafting technique of propagating selected trees. Mr D.J.N. Van der Hoop in Java not only used this method to multiply selected seedlings, but budgrafted them in seed gardens. In 1920 C. Heusser working in Sumatra commenced hand pollination between clones, and later these methods were introduced into Malaya. Major E.H.T. Gough selected 618 seedlings from a million *Hevea* trees in the Kajang district and budded them on Prang Besar Estate, which was closely followed by similar selection work by A.R. Sanderson and H. Sutcliffe of the Rubber Growers Association at Pataling. Mr L.E. Morris of the Rubber Research Institute of Malaya, which was founded in 1926, made the first series of hand pollination in Malaya during 1927. At Prang Besar in 1928 R.J. Chittenden also began to apply this method of breeding and selection of clones for seed gardens. Thus improved material yielding four times as much as the original seedlings has become available and now nearly a quarter of the area planted with Hevea in Malaya is carrying selected material.

The Department of Agriculture took over work on rubber after Ridley's retirement in 1912, but since its formation in 1926 the Rubber Research Institute has been responsible for investigations of this crop. The Botanic Gardens in Singapore have continued with many other tasks. One of the most important is the collection and preservation of plant specimens, their naming, identification and description. In the Centenary exhibition the methods were demonstrated by displays of plants named by Ridley and others named in his honour.

After much patient study the knowledge gathered about these plants has been published by the staff of the Gardens. Ridley's 'Flora of the Malay Peninsular' and the first two volumes published of the 'Flora of Malaya' by R.E. Holttum are examples of the more scientific descriptive works. On the other hand E.J.H. Corner's 'Wayside Trees of Malaya' and M.R. Henderson's Malayan Wild Flowers' have brought the study of Malayan plants within the scope of the layman. Ridley wrote the standard work 'Spices' and his successor I.H. Burkill prepared the 'Dictionary of the Economic products of the Malay Peninsular'.

There were also exhibits to show how the Gardens are maintaining a place in the forefront of international cooperation by exchange of specimens, seed and publications. Thus the Gardens continue the generous spirit of help and cooperation of its first Director, who sent plants from Singapore to every quarter of the globe.

The Botanic Gardens displayed its treasures of old books and beautiful paintings of flowers by artists. A colourful feature was a selection of orchids to illustrate progress in breeding new flowers. A topical note was struck by a new hybrid named after Mr Wong Peng Soon, whom

Her Majesty awarded an Hon. M.B.E. for his services to sport, and whom the botanists had already honoured in their own way.

The Gardens themselves, floodlit at night, formed a delightful setting for the centre of a valuable industry. Every visitor was appreciative of the careful preparation of this exhibition by the present Director, Mr J.W. Purseglove and his staff. We wish to thank him for permission to publish this account of the demonstrations at Singapore. Mr Purseglove is the fifth Director, all his predecessors are still living and in appreciation of the tradition they have maintained, we cannot do better than quote the message sent by Mr Ridley, the first Director, on his one hundredth birthday. 'I thank all my friends of Malaya for their good wishes and honours they have bestowed upon me on my one hundredth birthday. It is a great delight for me to have lived to see Malaya so prosperous, and the Gardens the best Tropical Gardens in the world.'

Correspondence

NATURAL RUBBER RESEARCH

Shortly after reading your editorial in the January issue of the Planters' Bulletin on the position of Natural Rubber and of research into natural rubber at the end of 1955, I came across the editorial in the current issue of the leading American Rubber Journal, *'Rubber World'*.

It is interesting how closely this editorial entitled 'Too Little and Too Late for Natural in U.S.A?' echoes your own thoughts, and coming as it does from the journal which may be considered the mouthpiece of the American manufacturing consumer, it may be of interest to your readers to quote the two closing paragraphs:

> 'In August, synthetic rubber captured the largest segment of the American market since the Korean War. The B.F. Goodrich Co., and the Firestone Tire and Rubber Co., both recently announced the development of a synthetic rubber with the same unit structure as natural rubber, and the Goodrich Company reports successful use of this rubber in truck and bus tires.
>
> If established types of general purpose and special synthetic rubbers have captured two thirds of the American market and if a new synthetic rubber can replace natural rubber in truck and bus tires, is it not possible that current and future efforts of the natural producing industry to hold one third of the American new rubber market may be too little and too late?'

'Too little and too late?' This final rhetorical question should be taken as a challenge and as such lends particular urgency to your own concluding remark on natural rubber research and development: 'Are we doing enough?'

H.M. Collier

Dunlop Malayan Estates Ltd.,

Malacca

Comment has appeared in other rubber journals, similar to that quoted by our correspondent. We intend to cover this in a future editorial—Editor

Courses for Senior Estate Conductors

No vacancies remain for the courses commencing 9 April, 23 April and 18 June as announced in our last issue. There are still a limited number available in the course commencing 4 June.

OUR COVER ILLUSTRATION SHOWS THREE OF THE TREES IN THE HISTORY OF TAPPING DISPLAY AT THE RIDLEY CENTENARY EXHIBITION, SINGAPORE BOTANIC GARDENS. FROM LEFT TO RIGHT; TAPPED BY HATCHET, SIMPLE HERRING BONE TAPPED BY CHISEL AND MALLET AND SEVERAL HERRING BONES ON ONE TREE.

See page 39

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